Fire-bellied Toad (*Bombinator igneus*), a Natterjack Toad (*Bufo calamita*), European, presented by Mr. H. A. Macpherson; six Green Tree Frogs (*Hyla arborea*), European, presented by Mr. A. Leipner, F.Z.S.; a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, deposited; two Rendall's Guinea Fowls (*Numida rendalli*) from West Africa, a Javan Peafowl (*Pavo spicifer*) from Java, three Royal Pythons (*Python regius*) from West Africa, received in exchange; two Saffron Finches (*Sycalis flaveola*), bred in the Gardens.

SOME RECENT EXPERIMENTS ON THE CRYSTALLISATION OF SUPERSATURATED SALINE SOLUTIONS[1]

THE history of the various views held by different experimenters on the nuclear action of substances in exciting the sudden crystallisation of a supersaturated solution, has been already so well described by Mr. Charles Tomlinson, Prof. Liversidge, Prof. Grenfell, and others in their several papers upon the subject, that it is unnecessary to enter into any detailed description of their opinions; suffice it to say that they may be divided into two classes: the first holding the opinion that the crystallisation may be excited by the presence of certain fatty, oily, greasy, or other matters in the form of films; the second that the initial cause of the crystallisation must be sought for in the entrance of a particle of the same salt as that which is in solution.

In 1866 M. Gernez indicated that in the case of certain salts the sudden crystallisation might be brought about by the agency of some other salt perfectly isomorphous with the one in solution; thus a supersaturated solution of magnesium sulphate invariably crystallised when crystals of zinc or nickel sulphates containing seven molecules of water in their composition were introduced. Having been for a long time interested in the crystallisation of such solutions, I determined to carry out a large number of experiments upon carefully purified substances which observations have resulted in a confirmation of the views held by Gernez that truly isomorphous substances are active to solutions of each other.

The two methods employed in the experiments may be briefly stated as follows:—(1) The supersaturated solutions of the salts to be examined were placed in small wide-mouthed flasks; and the solutions of the salts employed as nuclei were introduced into very thin glass bulbs plugged with cotton wool, and suspended through a second plug of cotton in the neck of the flask, in a manner such as is indicated in Fig. 1. (2) A large number of the experiments were also performed by using, instead of the bulb tube for the introduction of the salt employed as nucleus, a tube bent as a siphon, thus ∩∪, and like the bulb tube passing through cotton wool plugs in the necks of the flasks; the whole arrangement when complete being as represented in Fig. 2. To perform an experiment the solution in the bulb or in the siphon tubes was crystallised, and after a short time these tubes were gently lowered into the solutions in the flasks and the results observed. When the bulb tubes were used they were gently broken against the bottom of the flask, the contained crystals being thus brought in contact with the solution. To show that the disturbance produced by this breaking had of itself no exciting action on the solutions in the flasks, corresponding experiments were made with bulbs containing clean pieces of glass, when no crystallising action took place, showing that the mere disruption of the solution did not cause crystallisation. The largest number of experiments were, however, carried out by the siphon tube method, which is perfectly applicable after a little practice in the introduction of the tubes. The substances employed were in all cases carefully examined to ensure their purity.

With magnesium sulphate ($MgSO_4 . 7H_2O$) as a supersaturated solution, it was found that the other sulphates of the same group of metals, namely, those of zinc, nickel, cobalt, and iron, were immediately active in causing the crystallisation of the magnesium solution when they possessed an identical composition with it, as represented by the general formula ($M''SO_4 . 7H_2O$), M representing the different metals. When these salts contained only six proportions of water crystallisation is sometimes induced, but in this case it is of an entirely different nature, the deposition being slow and gradual. In connection with this group of salts interesting results were obtained with the double salt potassio-magnesic sulphate ($MgK_2(SO_4)_2 . 6H_2O$), crystals of which, although possessing the elements of magnesium sulphate, were found inactive to a solution of that body. In the case of supersaturated solutions of sodium sulphate ($Na_2SO_4 . 10H_2O$), the bodies sodium selenate ($Na_2SeO_4 . 10H_2O$), and sodium chromate ($Na_2CrO_4 . 10H_2O$), each analogous in form and constitution to the sulphates but containing the elements selenium and chromium instead of sulphur, were found capable of exciting crystallisation in solutions of the sulphate.

Experiments were also performed upon supersaturated solutions of potash alum ($AlK(SO_4)_2 12H_2O$), with crystals of iron and chromium potash alums, bodies agreeing in form and constitution with common alum, but containing chromium or iron in place of the metal aluminium. These bodies were found invariably active in exciting the crystallisation of the common alum solution. As alum crystallises in beautiful octahedral crystals some experiments were made to see how far the mere shape of the crystal could render it active in exciting the crystallisation; and for this purpose cubes of copper pyrites and octahedra of magnetite, both belonging to the same crystalline system as alum but having a different chemical structure, were employed. When these substances in a perfectly clear condition were placed in the alum solutions no sudden crystallisation was produced, showing that mere form alone is inactive in exciting this kind of crystallisation. Crystals of hydric disodic arsenate ($Na_2HAsO_4 . 12H_2O$) were also found active in the case of the isomorphous hydric disodic phosphate, containing phosphorus instead of arsenic, but otherwise analogous in form and composition. In connection with this latter salt it is worth noting that when the hydric disodic phosphate is heated to convert it into sodium pyrophosphate ($Na_4P_2O_7$), this substance is no longer active to a supersaturated solution of the disodic salt. At the same time corresponding experiments were performed on the supersaturated solutions of magnesium sulphate, alum, &c., with substances of dissimilar form and chemical constitution; these bodies, however, invariably yielded negative results, being incapable of exciting the sudden crystallisation of the solutions.

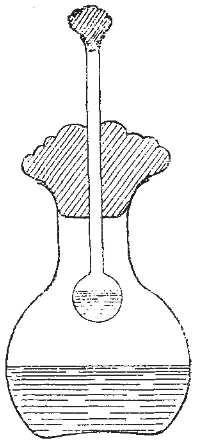

Fig. 1.

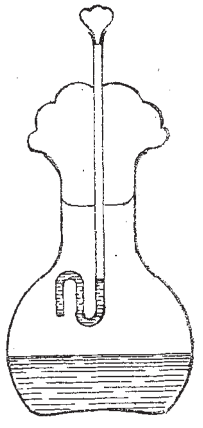

Fig. 2.

Experiments carried out upon mixtures of similarly constituted and dissimilar bodies, yielded some interesting results. The substances employed were mixtures of the similarly constituted sulphates of magnesium and nickel, and the dissimilar sulphates of magnesium and sodium; experiments were also made with sulphates of nickel and sodium. In the case of these mixtures it was observed that two results might occur:—(A) The nucleus might remain growing in the solution without causing immediate crystallisation; or (B), Crystallisation might be induced at once on the addition of the nucleus; the deposition of the salts, however, differs according to the nature of the substances employed.

In the case of the dissimilar bodies, magnesium or nickel sulphates with sodium sulphate, it was found that a nucleus of either sulphate when gradual crystallisation took place, slowly increased by a deposition of the substance of the same nature as the nucleus added; and that even with the rapid crystallisation of dissimilar bodies the salt deposited consisted essentially of the substance of the same nature as the nucleus added.

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[1] Abstract of a paper read before the Chemical Society on March 6, 1879.

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With mixtures of isomorphous salts, however, the results were different. In these cases sudden crystallisation on touching with a nucleus producing a separation of both the sulphates apparently always in the proportions in which they existed in the solution. When gradual crystallisation took place with the sulphates of nickel and magnesium the nucleus increased by a deposition of the least soluble salt independent of the nature of the nucleus added. It may be seen therefore from these experiments that truly isomorphous bodies, that is, substances not only possessing the same form but also an identical chemical structure, may be regarded as active nuclei in exciting the sudden crystallisation of supersaturated solutions of each other. I hope shortly to extend the observations upon supersaturated solutions of mixtures, and of compound salts, employing their different constituents as nuclei, as I think by such experiments some light may be thrown upon the relations between these constituents when associated together in solution. There are, however, very few true double salts of which it is possible to obtain thoroughly supersaturated solutions. JOHN M. THOMSON

ON THE EARLY STAGES OF THE CÆCILIANS

THERE are few groups of vertebrates respecting whose life-history and development so little is known, as the curious snake-like amphibians forming the order *Peromela*, and usually known as Cæcilians. In all the ordinary zoological text-books in use in this country, the early stages of these animals are either left entirely unnoticed, or, at most, allusion is made to Johannes Müller's classical discovery of gill-slits in the young of *Epicrium glutinosum*. Even Prof. Huxley, in his article on the Amphibia in the first volume of the "Encyclopædia Britannica," published in 1875, after an allusion to Müller's discovery, states:—"It is to be regretted that nothing is known of the development of the Peromela" (*loc. cit.* p. 770).

This being the case, it may be useful to call attention to two papers on the development of the Cæcilians, by Dr. Peters, the eminent German naturalist, read by him before the Royal Academy of Sciences of Berlin, and published in their *Monatsberichte*, as their contents seem to be unknown to, or overlooked by, the bulk of English zoologists. The first of these bears the date of January, 1874, the second was read eighteen months later (July 19, 1875). In the first of these Dr. Peters, after noticing the discovery by Müller of gill-slits in *Epicrium*, and its subsequent confirmation by himself (*cf. Monatsbericht*, 1864, p. 303) continues, "it was therefore extremely interesting to me to learn from Prof. Wrzensniowski of Warsaw, who last summer honoured me with a visit, that some years ago the naturalist-traveller Constantin Jelski had sent him from Cayenne a gravid *Cæcilia*, which after its capture had given birth to a young one, and had contained in its uterus several full-grown embryos. Herr Wrzensniowski has now sent me for examination three of the young ones, and the old animal, referable to *Cæcilia compressicauda* (Dum. and Bibr.), and has given with them the following notes, part of which are extremely interesting." These notes are extracted from a letter of Jelski's, dated from Cayenne, November 12, 1866, to Herr Taczanowski, the well-known Polish zoologist, in which he gives his account of an expedition to East Guiana, to a plantation called "Bon Père," belonging to a M. Lalanne, from which he had just returned. After narrating the method of fishing by means of nets adopted, and the great abundance of fish, Jelski continues—"'In the course of the hunt, the negro who was frightening the fish away from the bank, suddenly uttered a loud cry: we all saw something that looked like an electric eel swimming about with worm-like movements just under the surface of the water. M. Lalanne and I held back the negro, who was about to cut the animal into bits with his sword, the net was hauled up, and the creature landed. We all thought it was an eel, but on closer examination decided that it was a gigantic water-worm. I put the creature into a special vessel, and as I had already fish enough, and did not hope to obtain any others, went home. As I was taking this problematical creature out of the vessel, to put it into the calabash, I saw two of them instead of one. The old one had produced a young one. After I had laid the old one on the table, I examined it more closely; it exhibited very slow, tremulous, slight movements. Shortly afterwards I found it in true convulsions. I perceived that it was about to produce a second young one. I placed it in spirit, so as to convince people of its being viviparous. Membranes (*Häute*) were ejected together with the first young one.' Herr Wrzensniowski adds—'After the receipt of the animal, I dissected it myself, and found in the oviduct five young, which I at once extracted, and two of which I send you together with the one that was born in Cayenne. All these examples that were removed from the oviducts were remarkable for a membranous outgrowth on the necks which was very easily torn off, and left a transverse linear scar, as in the specimen born in Cayenne, so that only a single specimen has retained this outgrowth till now. In the uterus I perceived nothing else noteworthy; the embryos lay in a dilatation of both oviducts, just as they now are in the spirit, without being covered by any membranous envelopes. I conclude therefore that the membranes, which, according to Herr Jelski, were extruded together with the young one from the oviduct were nothing else than the shed neck-vesicles (*Nackenblase*), which we could not find again in the parcel from Cayenne.'"

"The female forwarded to me, whose oviducts had been removed, was fifty cm. long, and four cm. deep in the middle; its head measured three cm.; of the young ones, the newly-born one, and one of the embryos, had a length of 157 millims., and a depth of twelve millims.; their heads measured eleven millims.; the other was only 136 millims. long and twelve millims. deep; its head was ten millims. They show no trace of the skinny vertical swimming-tail (*Flossensaum*) which both J. Müller and myself found on the hinder ends of the young *E. glutinosum*. But what surprised me much more was that there was no trace to be found of lateral gill-openings, like those which have now been discovered in several young examples of *Epicrium glutinosum*. The head and fore part of the body in all three specimens lay bent back towards the sides of the belly, so that apparently in the uterus this curved part, that is the under side of the head, is closely applied to the body, and the end of the body also seems to have been recurved towards the sides of the belly. From the neck of the one specimen two smooth vesicles, fifty-five millims. long, of irregular shape, and variously constricted, project; on them a blood vessel ramifies, whilst at their narrow transverse base they are connected together, though unfortunately no more can be learnt as to their original position, except that from their flat convex-concave form they are probably closely applied to the body.[1] On the transverse scar, where the epidermis is absent, which these vesicles leave after falling off, on each side a small hole is visible, the lumen of one or two vessels, which are in connection with the aortic arches of their side. These vesicles therefore are external gills, which resemble the bell-shaped external gills which Dr. Weinland discovered in the larvæ which develop in the external dorsal pouch in the female *Notodelphys* (*Opisthodelphys*) *ovifera*, and which he has described so well and thoroughly (Müll. *Archiv*, 1854, p. 457, Taf. xviii., Fig. 5, 6)." After some prefatory remarks on the distribution of the vessels to these bladder-like gills, Dr. Peters concludes:—"In any case, this discovery of a new agreement in the development of the Cæcilians with the other Batrachians is one of the greatest scientific interest, for in fact, not only is there now no doubt that, as in the *Anura*, so also amongst the Cæcilians a different gill-structure (*Kiemenbildung*) obtains, but it can also now be stated with certainty that in these animals also, for which the establishment of a third class or sub-class of Amphibians has even been proprosed, no amnion or allantois are developed, that, in part at least, they are viviparous, and that, at a certain period of the year, they are to be sought for, not in moist earth, but in water. Moreover, it is extremely probable that these animals, which only occur to fishermen rarely, and at a certain season, are not recognised by them, but are in fact shunned and destroyed on account of their ugly and worm-like aspect, and on this account so rarely come into the hands of collectors in their larval state."

In his second paper, read July 19, 1875, Dr. Peters contributes some further notes on the same subject, giving figures illustrating the young *Cæcilia* with its bladder-like gills still *in situ*, as well as the scars left on the neck after the fall of the gills, and the distribution and relations of the great vessels and aortic arches. The bulk of the paper is taken up with an account of the anatomy of the young Cæcilians, but a few additional remarks on other points are given which we here reproduce. "As was there (*i.e.* in his first paper) stated, in this species the embryos at birth are at most three and two-thirds smaller than the mother. It is also known that the young of *Epicrium glutinosum*, in which

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[1] This is also very probable from the observations of Weinland on *Opisthodelphys ovifera*, where the bell-shaped gills envelope most of the body.

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